



Norwegian  
Meteorological  
Institute

# Impact studies of ASCAT winds in rapidly developing storms

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# Outline

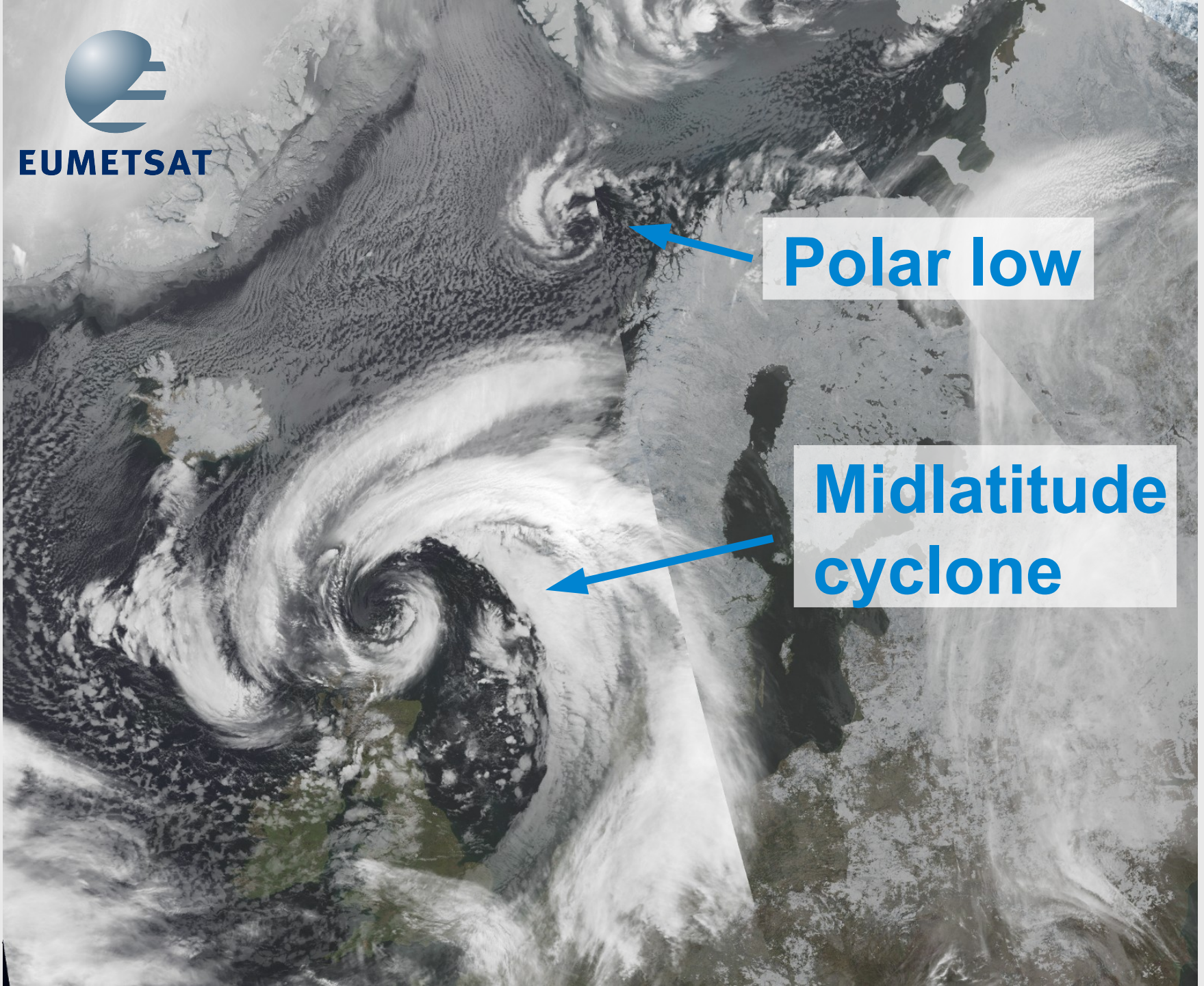
- Introduction
- ASCAT data usage in the HARMONIE NWP model in Norway
- Background and analysis departures
- Impact of ASCAT data assimilation on the forecast over land
- Conclusions



**EUMETSAT**

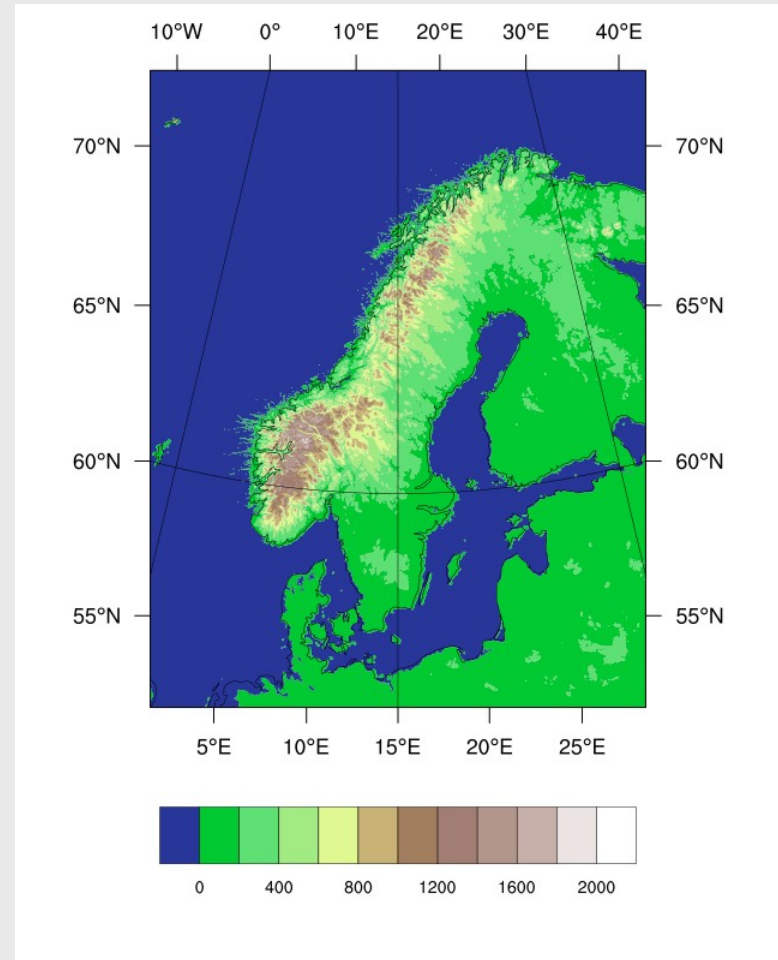
**Polar low**

**Midlatitude cyclone**



# Experimental setup

- HARMONIE 37h1.2
- METCOOP25B domain
- Grid size 2.5 km
- ECMWF forecast used at boundaries
- 3DVar with 3-h assimilation cycle
- Two cases:
  - **Hilde storm:** Midlatitude cyclone in November 2013
  - **Polar low week:** March 2013



# Questions

## Data usage:

- What is the spatial and temporal ASCAT data coverage in the domain used operational domain?
- Which data are used in the data assimilation? Does the wind ambiguity selection work properly, specially close to the fronts and storm cores?

## Observation departures:

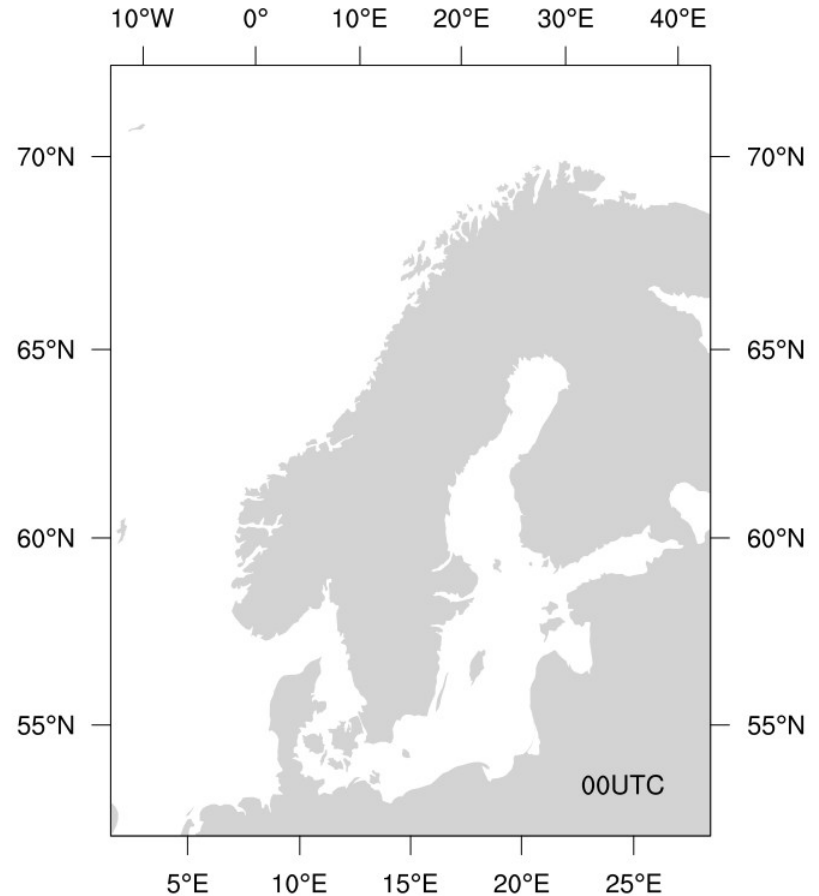
- How are the ASCAT winds compared to the model forecasts (background) and the analysis (initial state)?

## Forecast impact:

- Do ASCAT winds have an impact on the forecast?

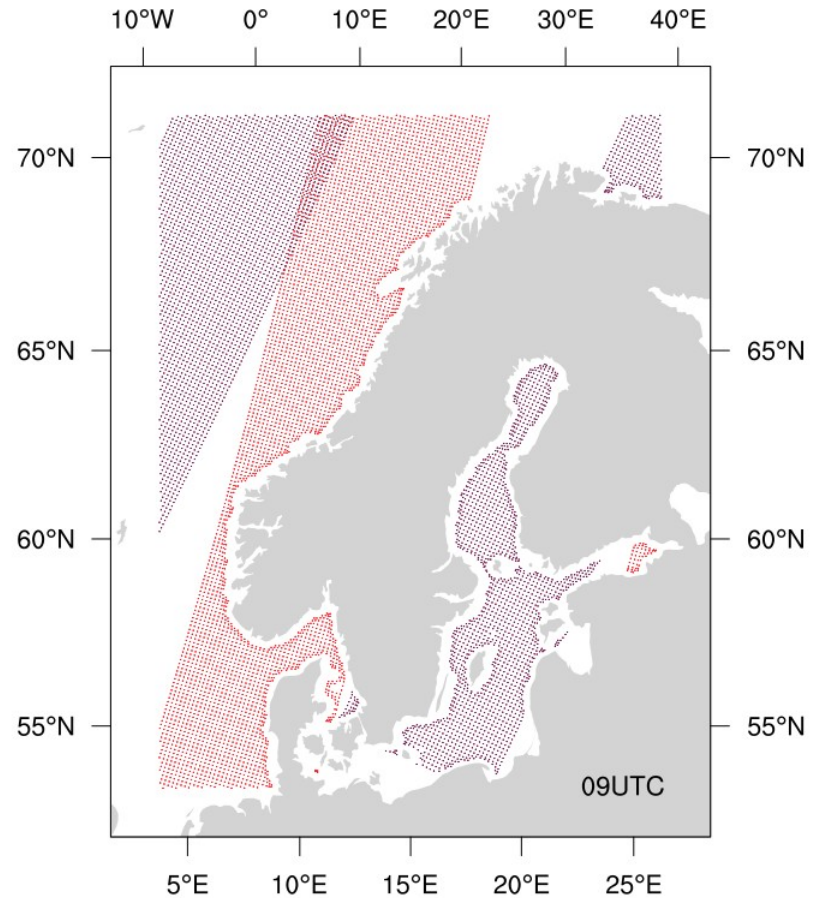
# ASCAT data usage in the weather prediction model

- ASCAT Global OSI-SAF Coastal product, 12.5km grid size
- Default thinning is set by the thinning factor of 4 → thinning distance of ~100 km
- Two ambiguous wind solutions are used in the data assimilation
- Observation error for ASCAT is 2.0 m/s as default



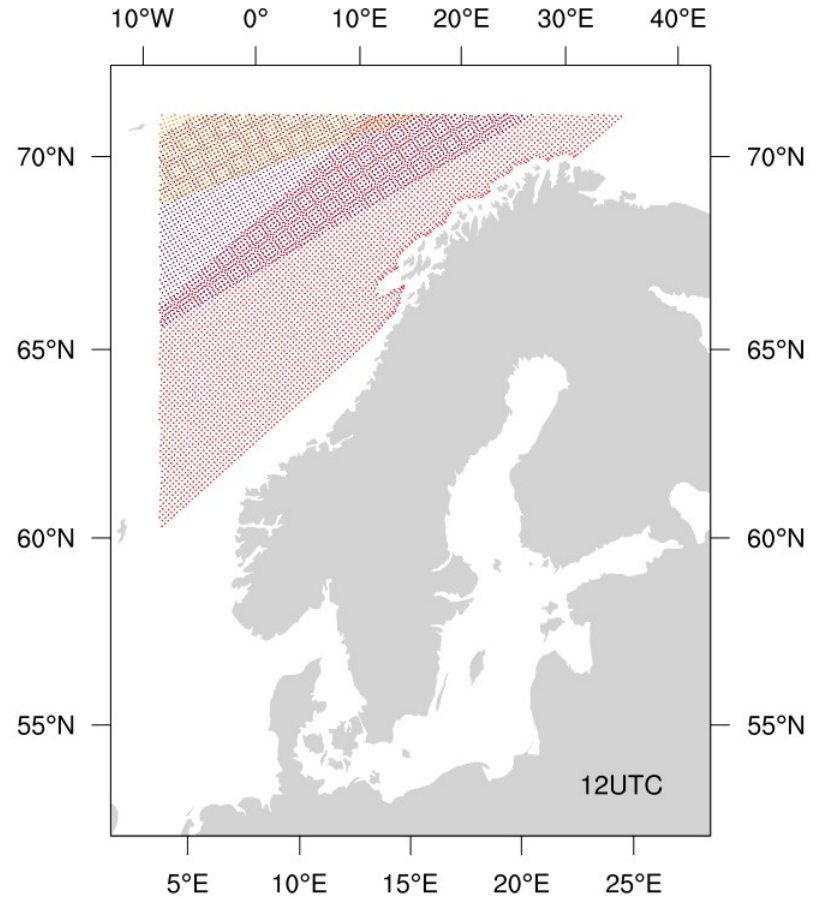
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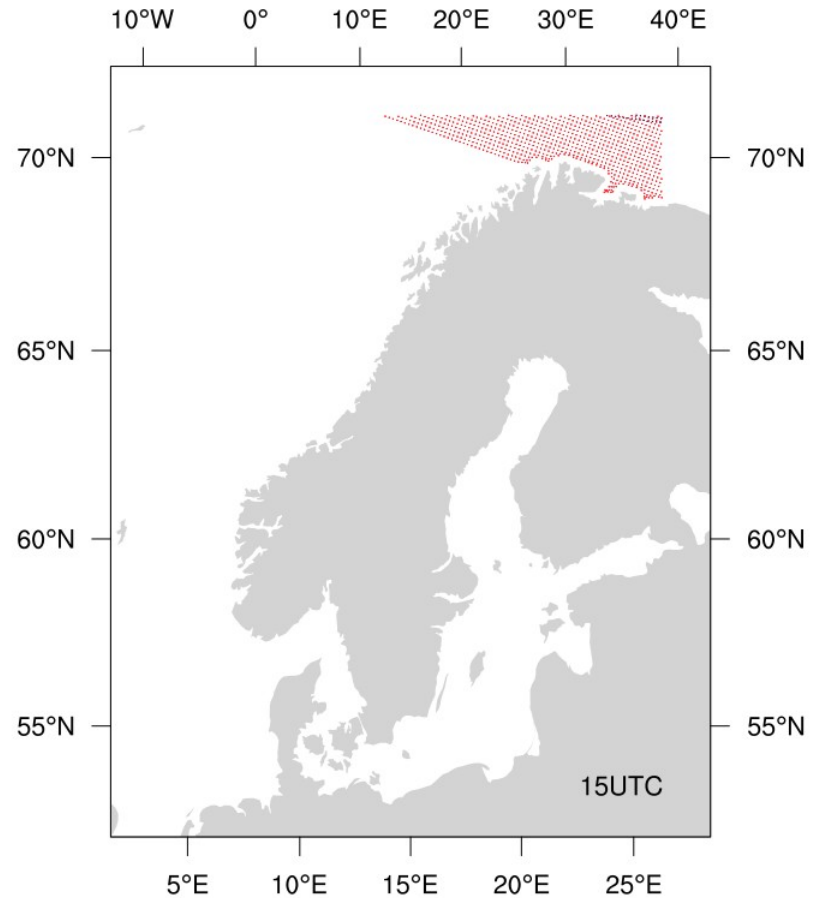
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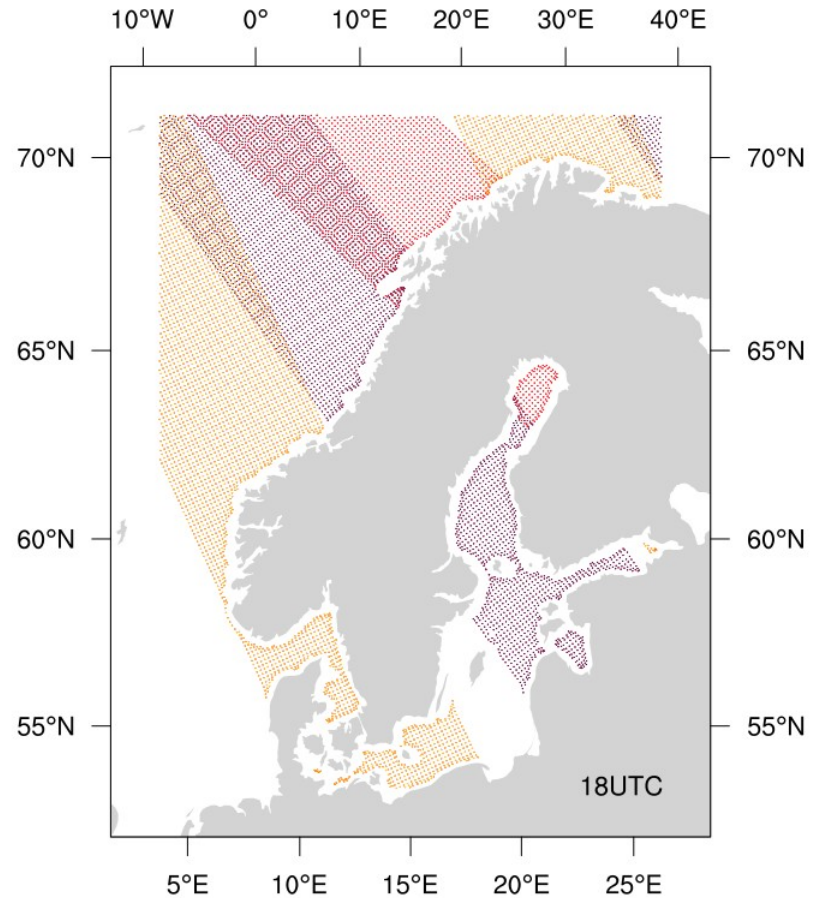
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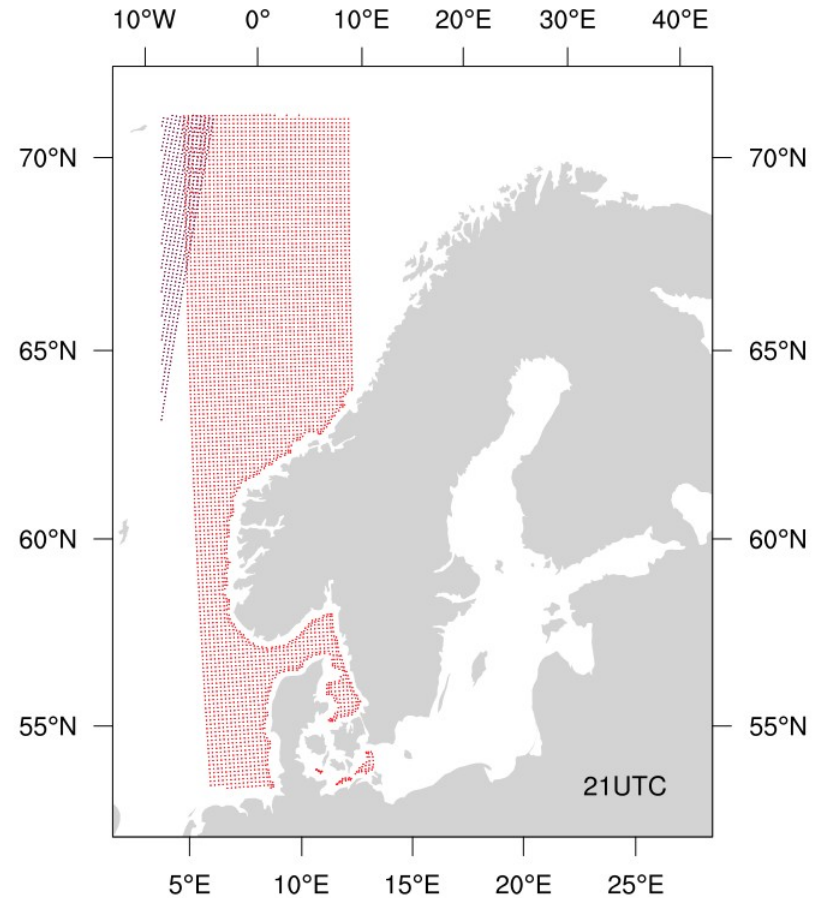
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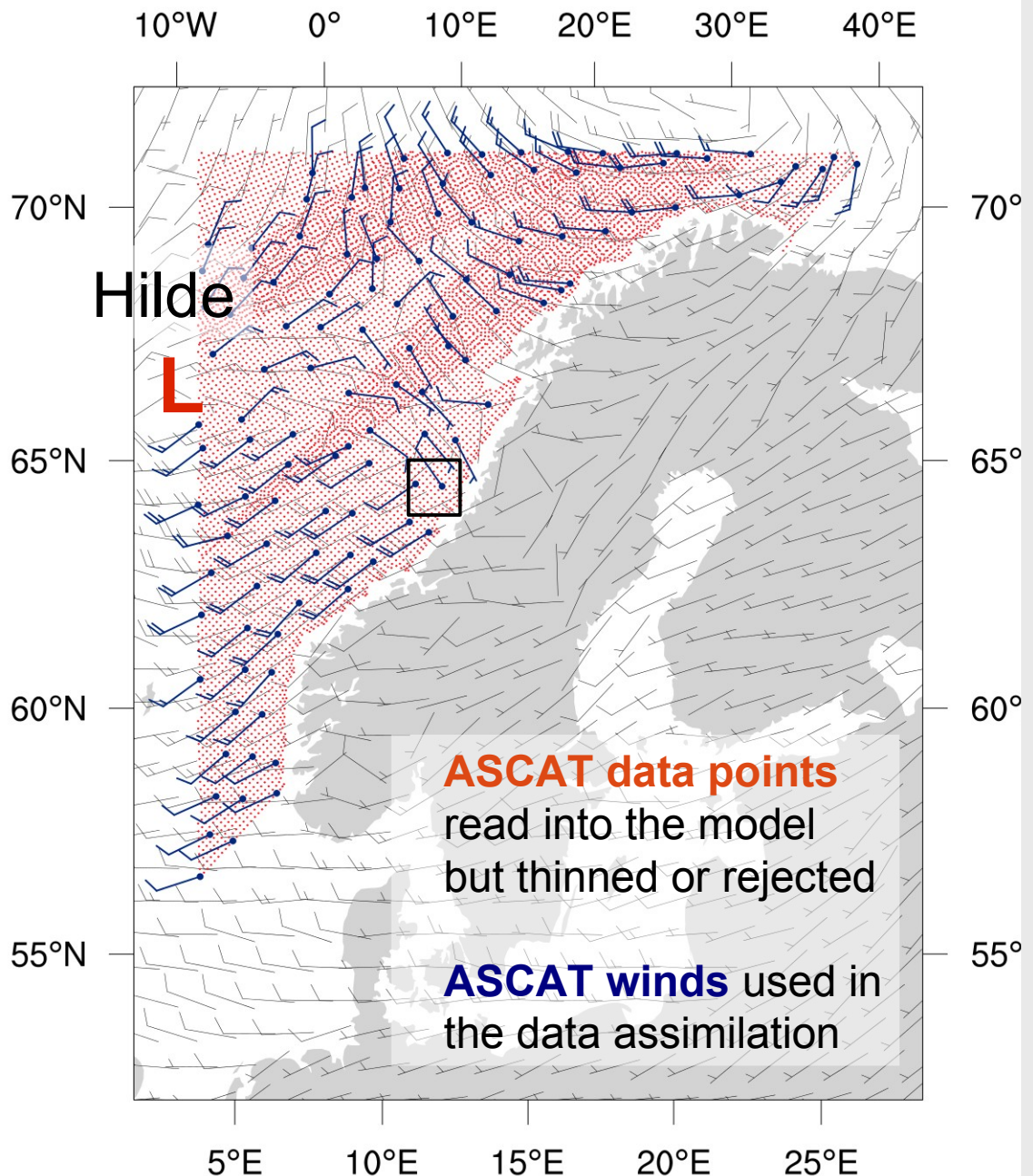
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# Data usage

- Data thinning by factor of 4 → thinning distance of ~100 km
- Data rejection close to the storm core
- Individual ambiguity selection problems related to the moving fronts

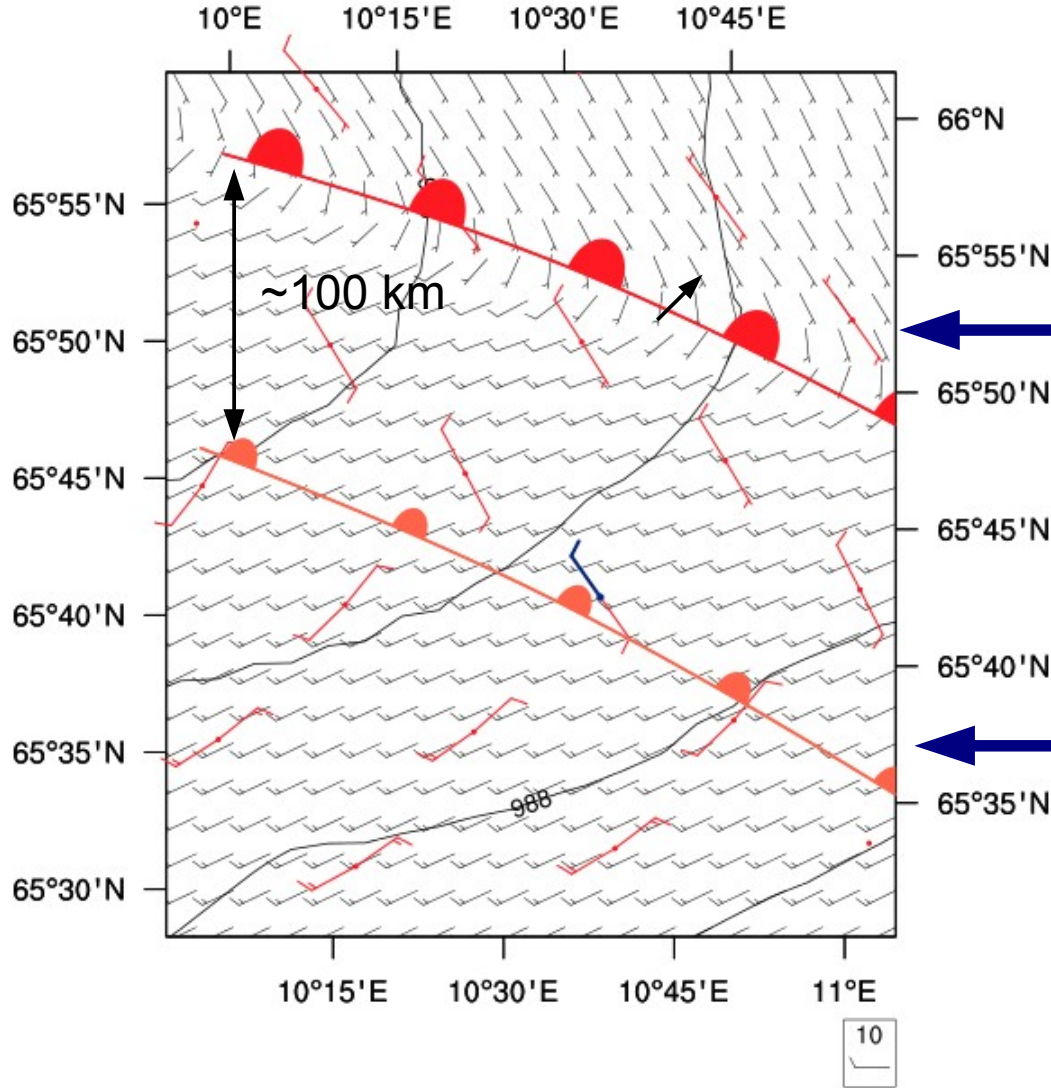
**Hilde Storm**  
Default thinning



ASCAT winds  
read into the  
model but  
rejected

ASCAT winds  
used in the  
data  
assimilation

Black wind  
arrows  
Harmonie  
winds in full  
resolution



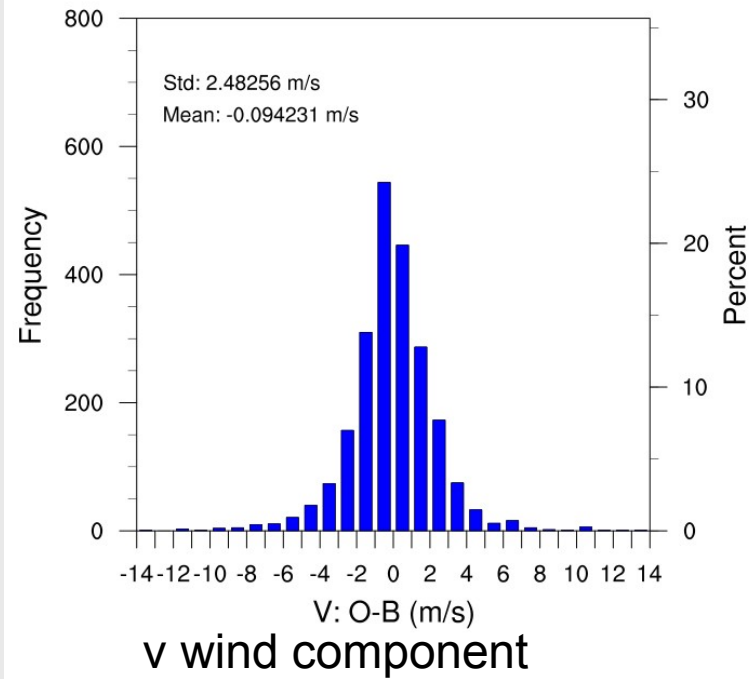
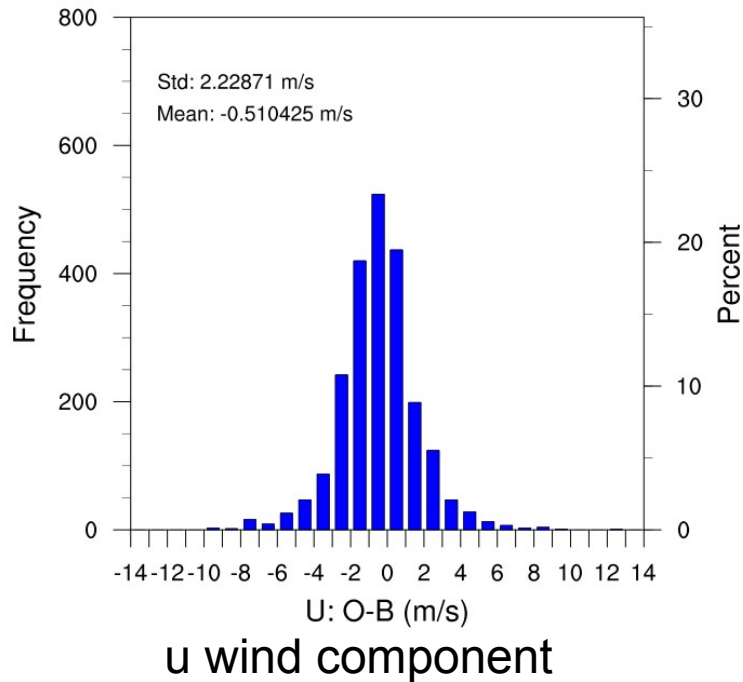
Warm front in  
first guess

Analysis  
Time 12 UTC

Warm front of  
ASCAT winds

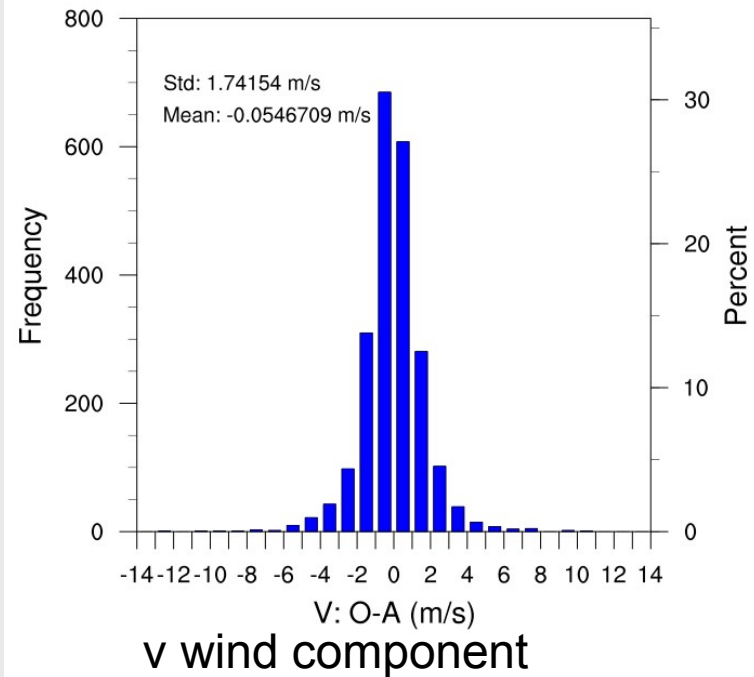
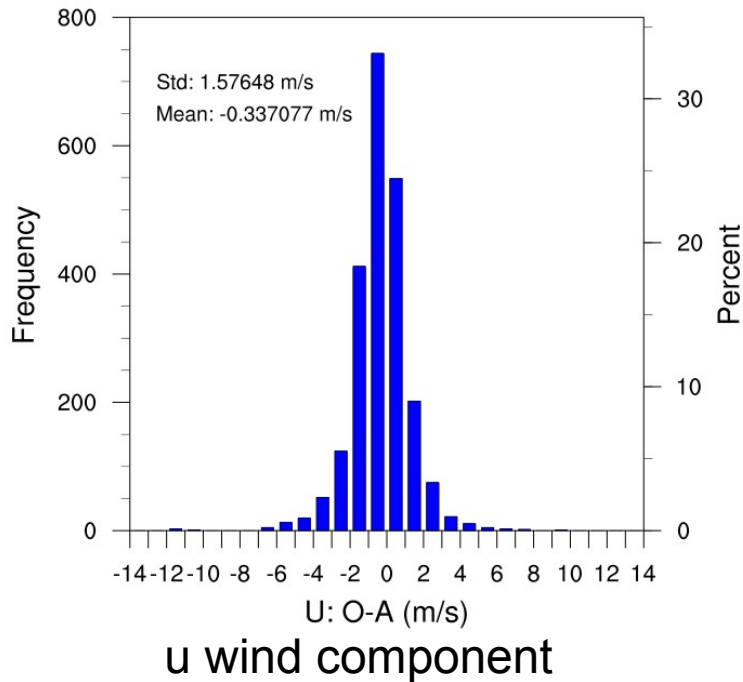
Measurement  
time  
11:16 UTC

# Observation departures



**Hilde Storm**  
Default thinning

# Observation departures



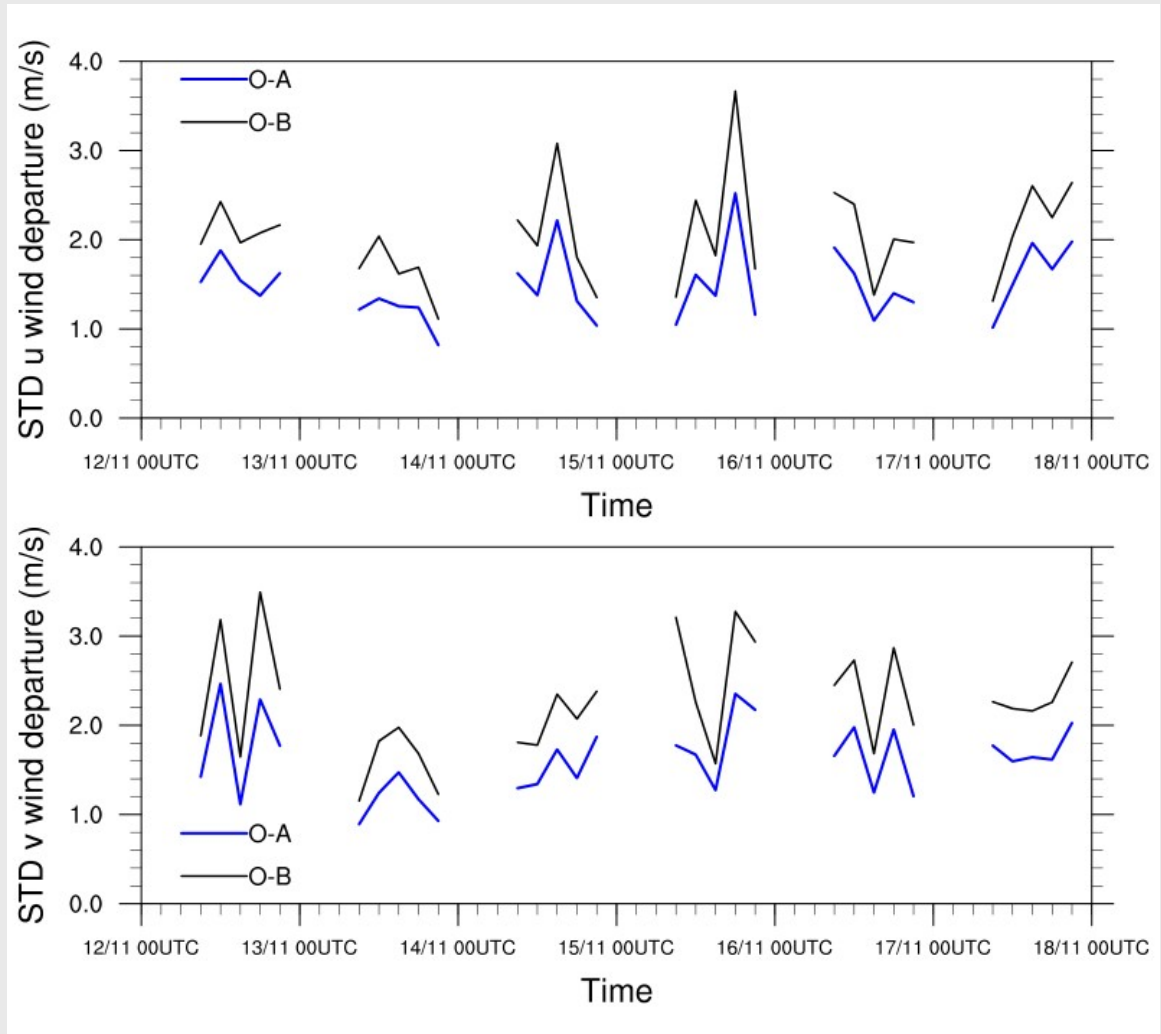
- The standard deviation of the analysis departure appr. 30 % smaller than the background departure
- The standard deviation of background (2.2 m/s, 2.5 m/s) is higher than the observation error set in the system (2.0 m/s)

**Hilde Storm**  
Default thinning

# Observation departures

- Background departure: Observation – background O-B
- Analysis departure: Observation – analysis O-A
- Day-to-day variations in the std
- The analysis has been changed closer to the ASCAT wind retrieval

**Hilde Storm**  
Default thinning

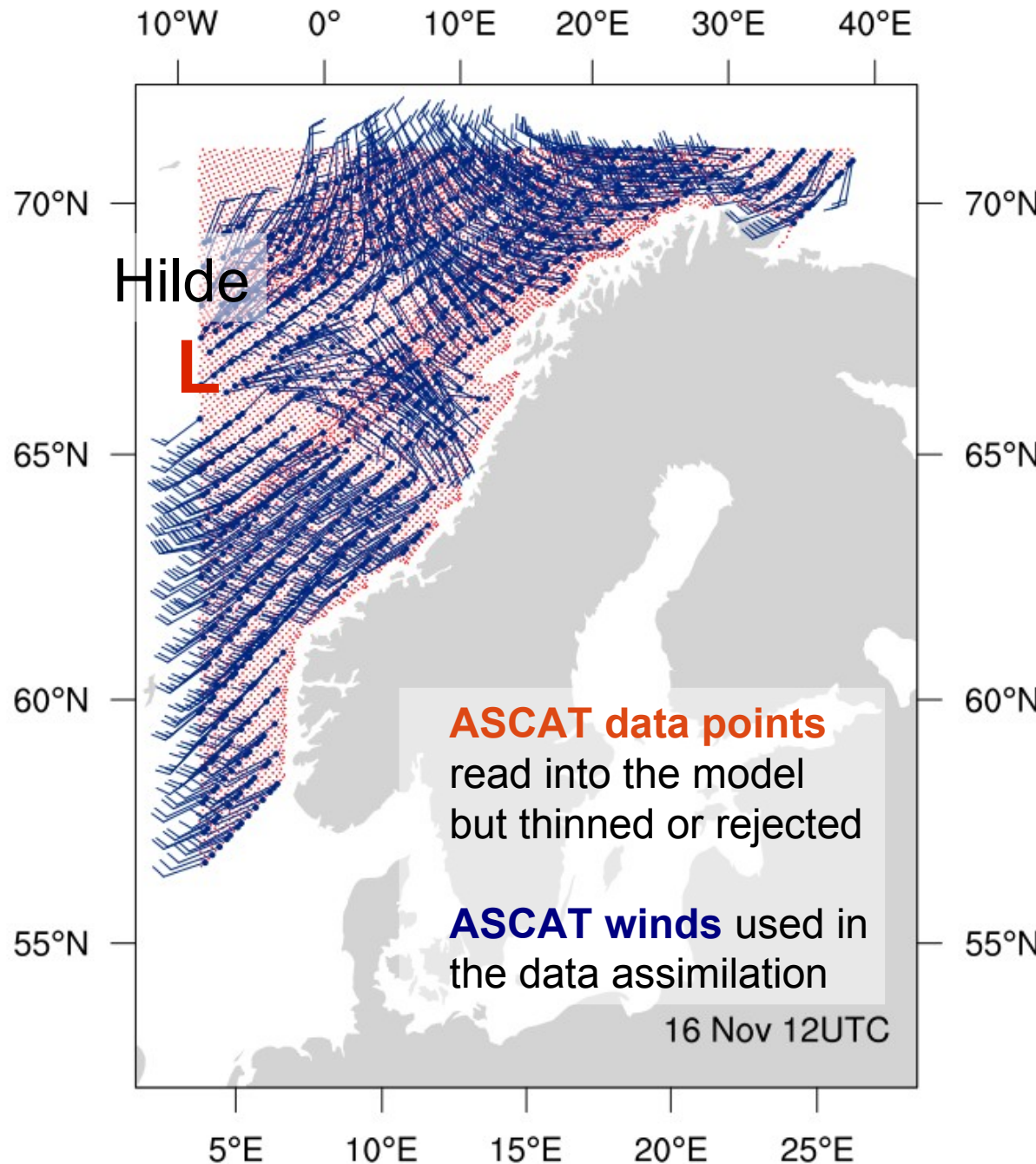




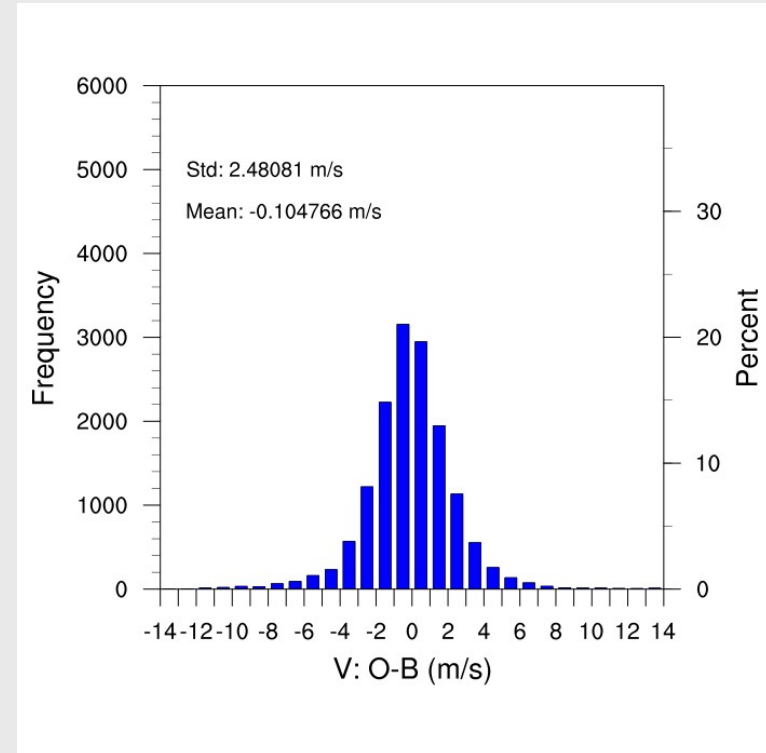
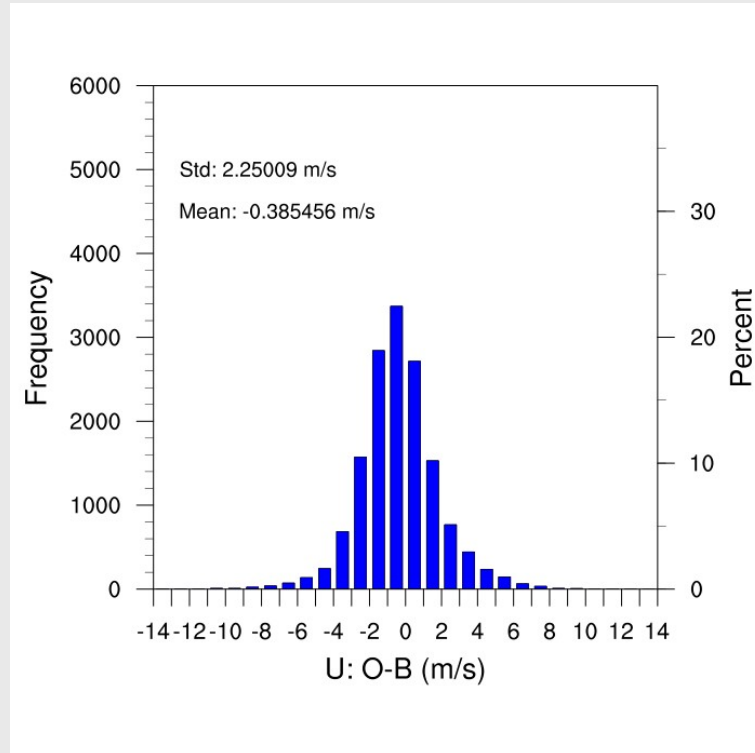
# Data usage

- Data thinning by factor of 1 → thinning distance of ~50 km
- Data rejection close to the storm core
- Ambiguity selection problems related to the moving fronts

## Hilde Storm Reduced thinning



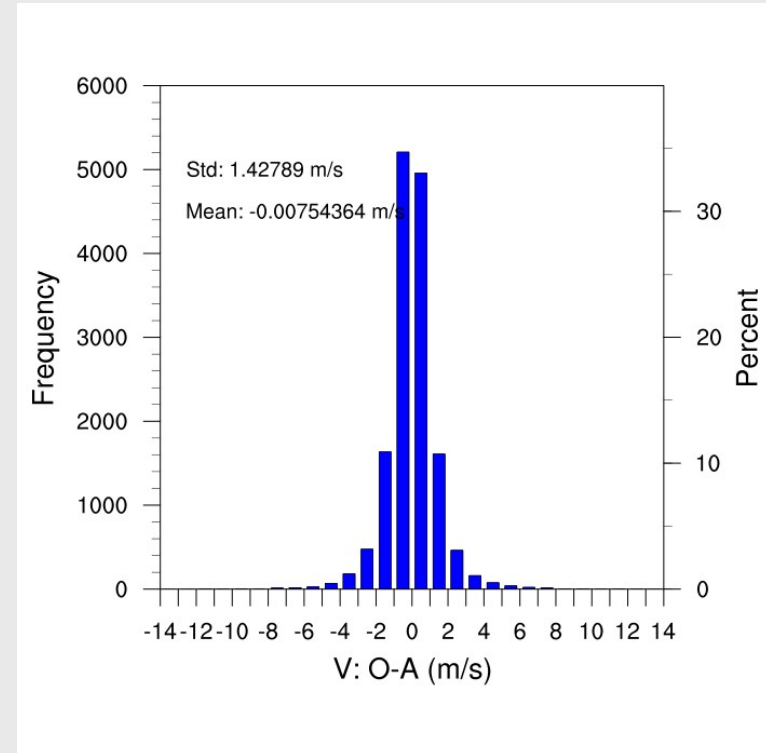
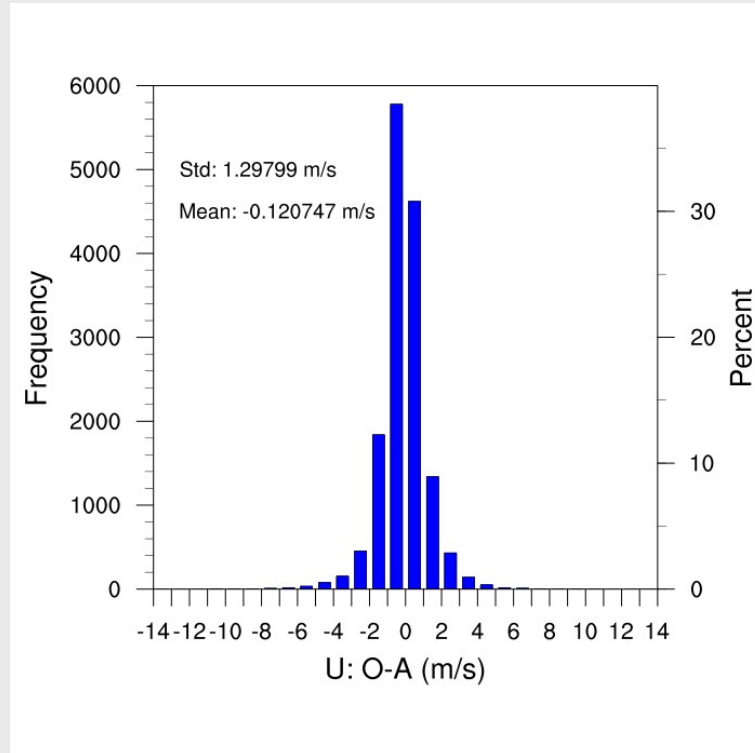
# Observation departures



- Larger O-B std when reduced thinning

**Hilde Storm**  
Reduced thinning

# Observation departures



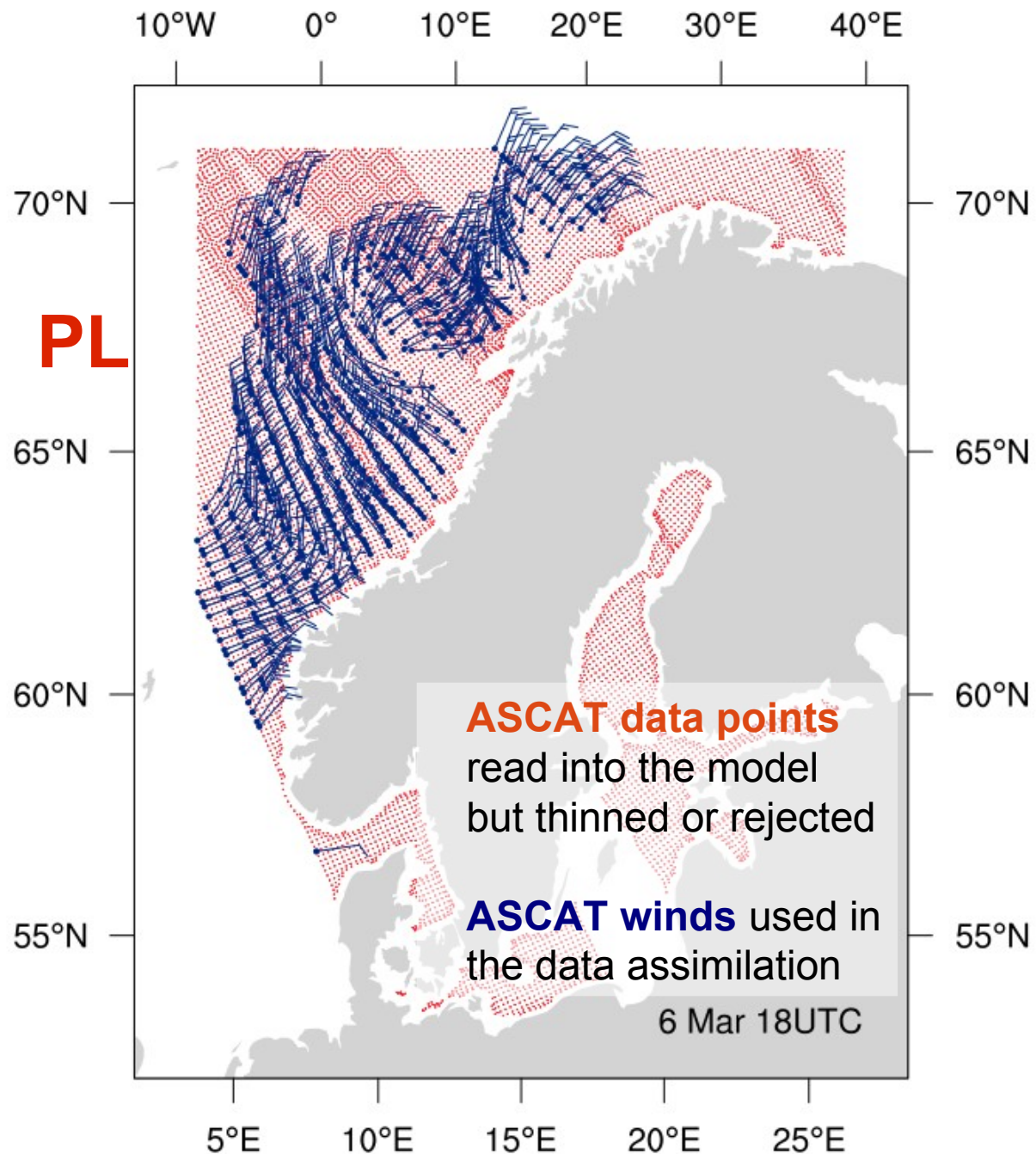
- Smaller O-A std when reduced thinning
- More weight on the observations

**Hilde Storm**  
Reduced thinning

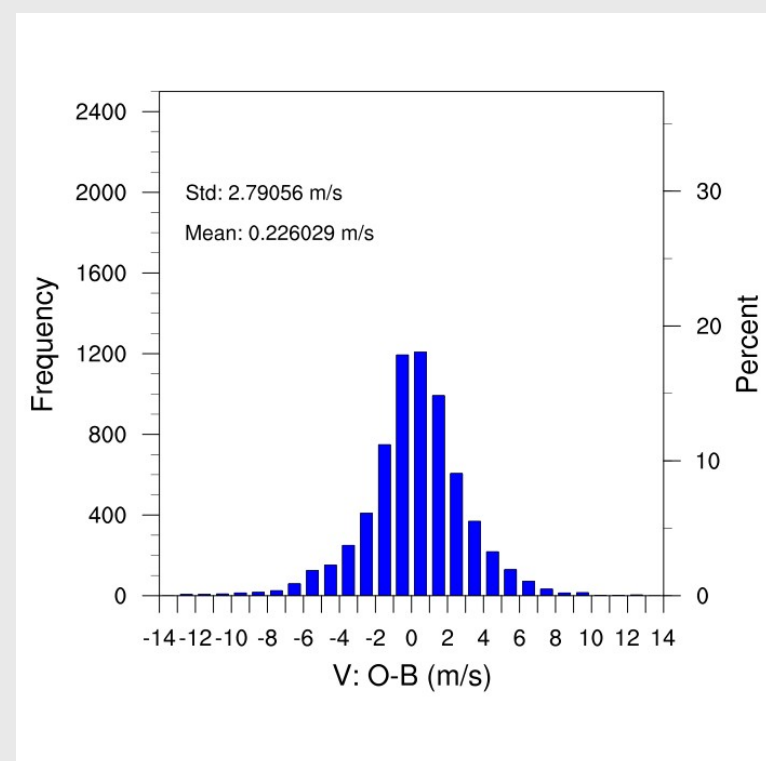
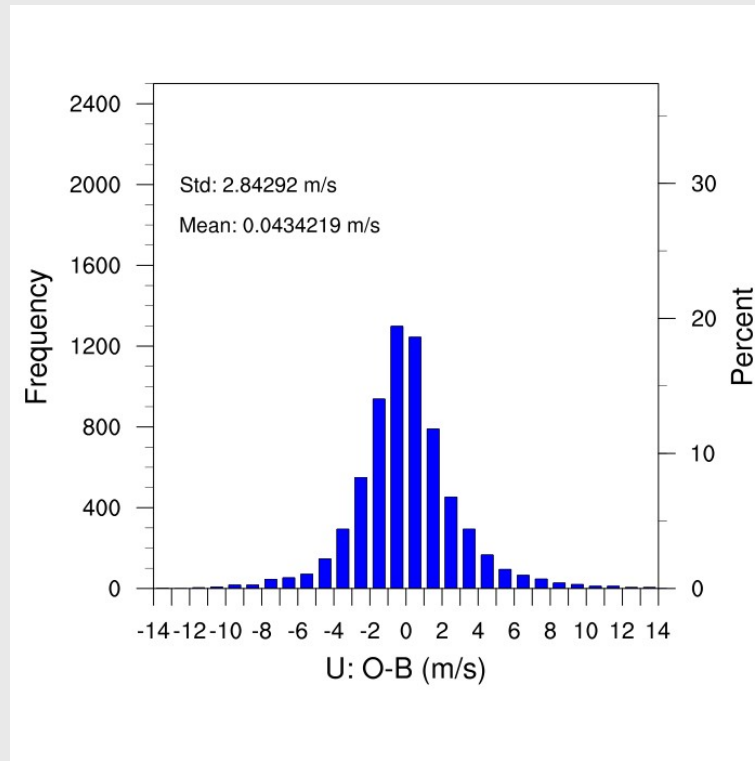
# Data usage

- Data thinning by factor of 1 → thinning distance of ~50 km
- Data rejection close to the polar low but also along the coast and close to the domain boundaries

**Polar low week**  
Reduced thinning



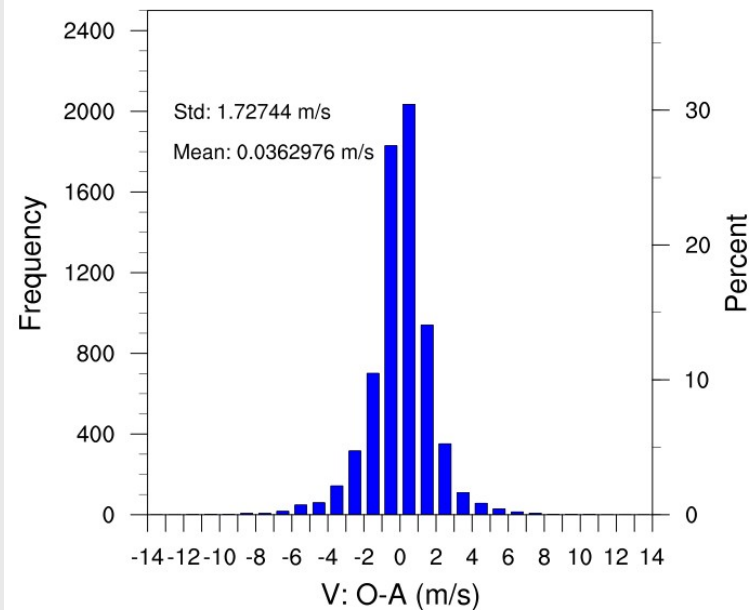
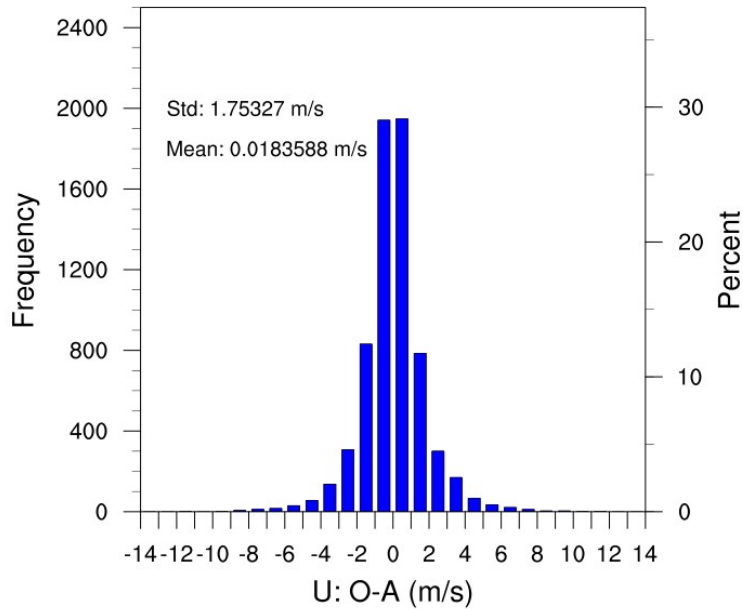
# Observation departures



- Stds are larger than for the Hilde case

**Polar low week**  
Reduced thinning

# Observation departures

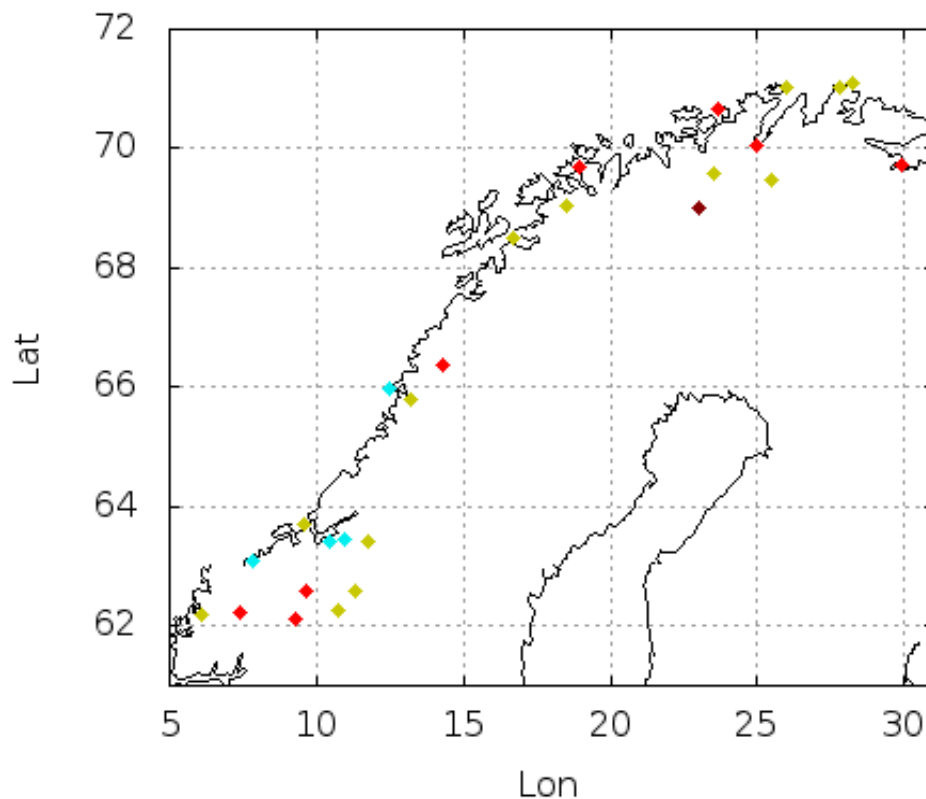


- Stds are larger than for the Hilde case

**Polar low week**  
Reduced thinning

# Forecast impact: SYNOP

26 stations used for the evaluation



Variables to evaluate:

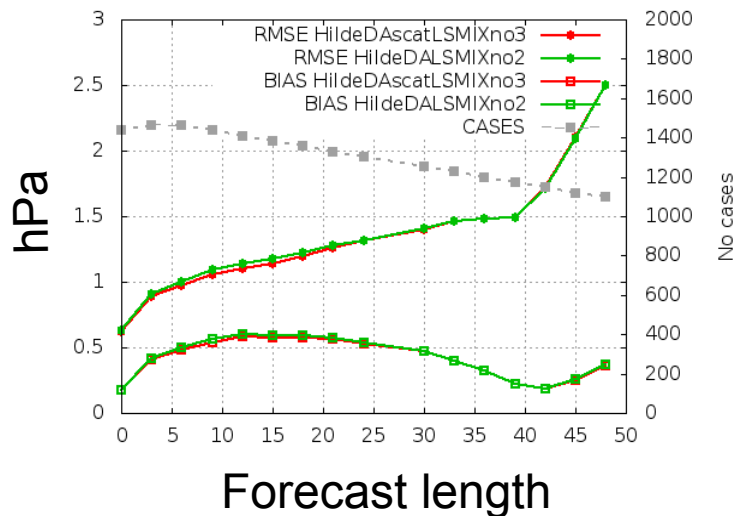
- Mean sea level pressure (mslp)
- 10 m wind speed (U10)

Scores:

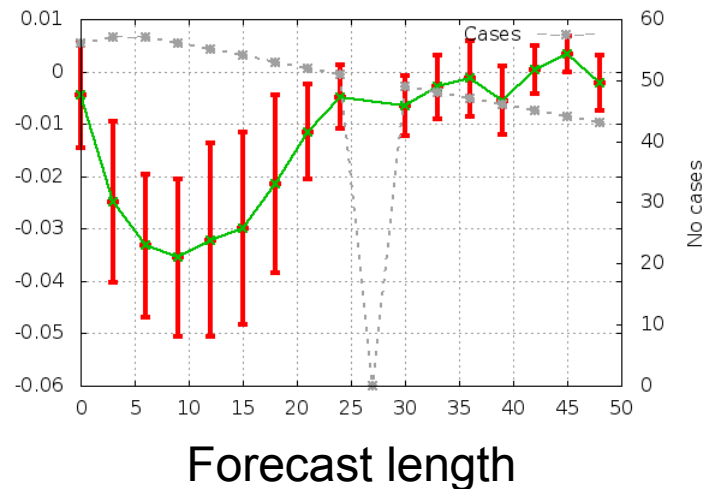
- Bias and RMSE as forecast length

# Forecast impact: SYNOP mslp

RMSE and bias of mslp



Difference (90 % confidence)



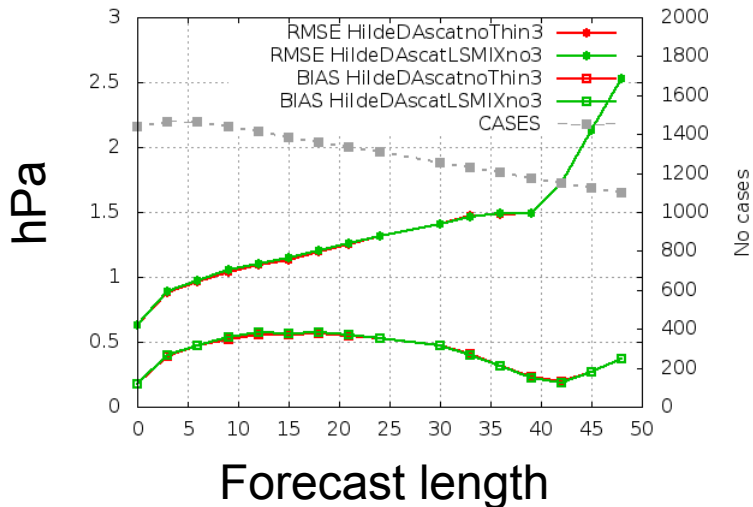
**With ASCAT winds – 100 km thinning**  
**Without ASCAT winds**

**Hilde Storm**  
 Default thinning



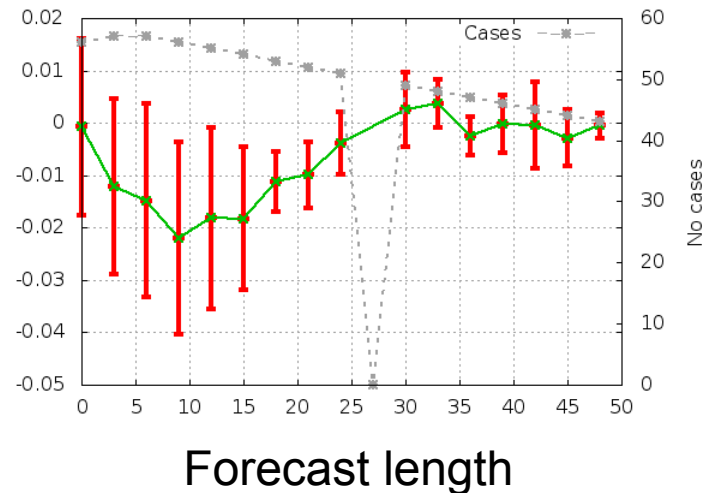
# Forecast impact: SYNOP mslp

RMSE and bias of mslp



**With ASCAT winds – 50 km thinning**  
**With ASCAT winds – 100 km thinning**

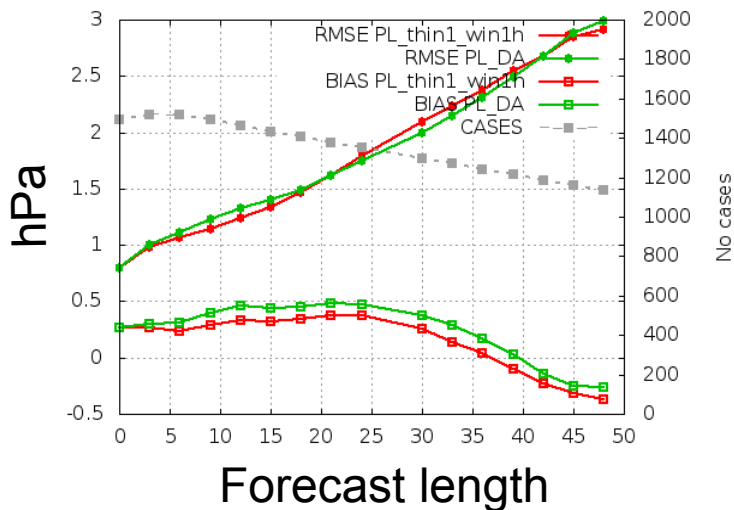
Difference (90 % confidence)



**Hilde Storm**  
 Default & reduced thinning

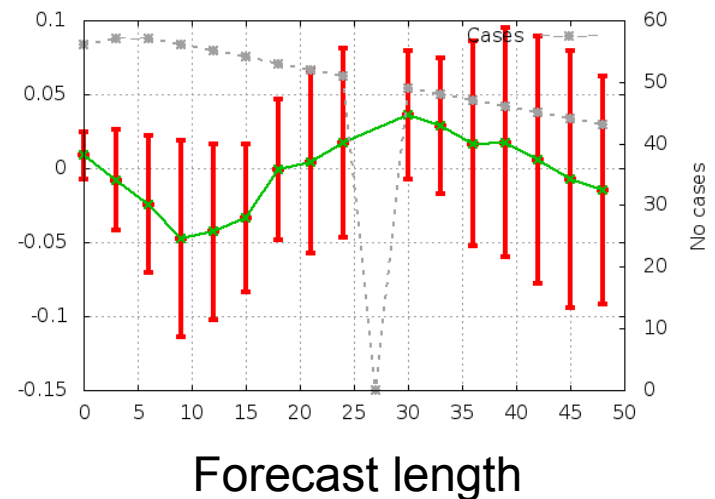
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RMSE and bias of mslp



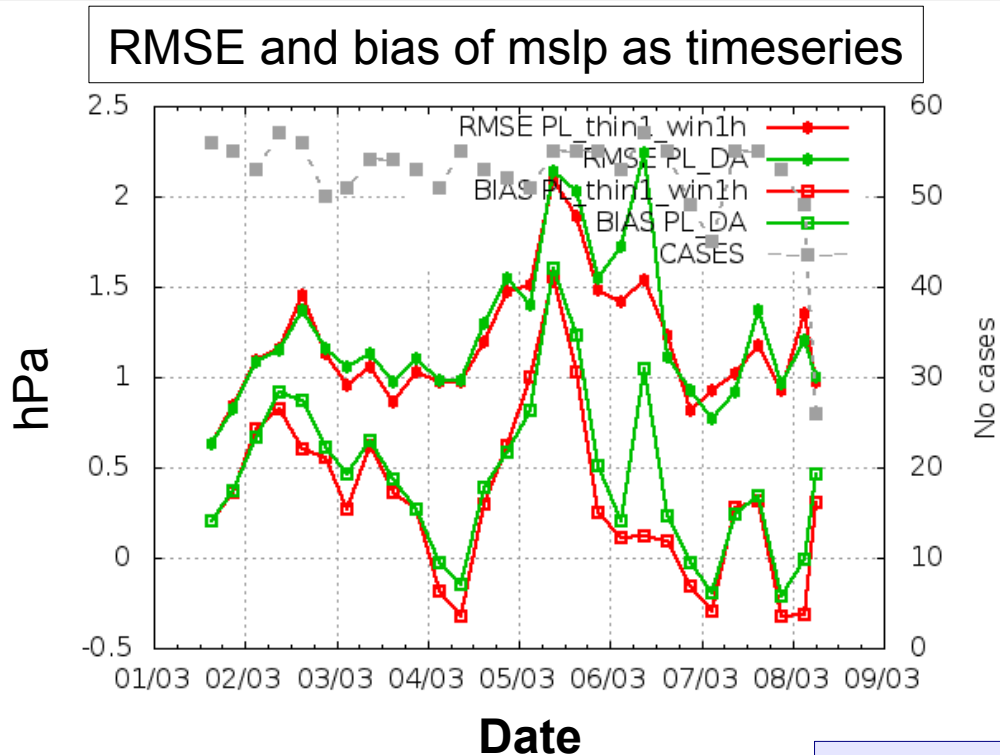
**With ASCAT winds – 50 km thinning**  
**Without ASCAT winds**

Difference (90 % confidence)



**Polar low week**  
 Redused thinning

# Forecast impact: SYNOP mslp



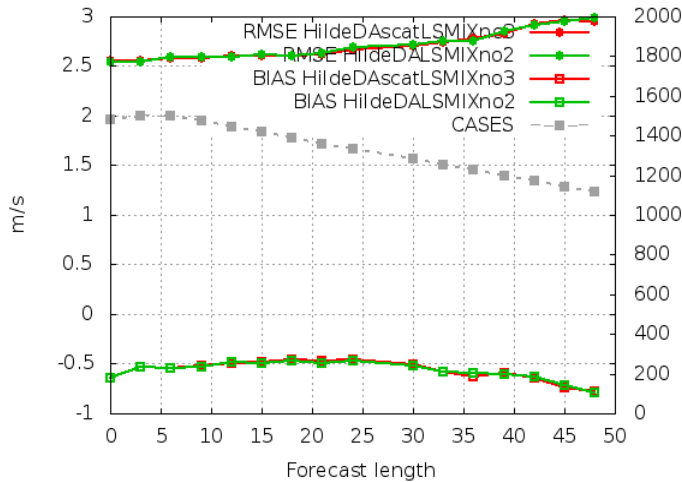
**With ASCAT winds – 50 km thinning**  
**Without ASCAT winds**

**Polar low week**  
Reduced thinning

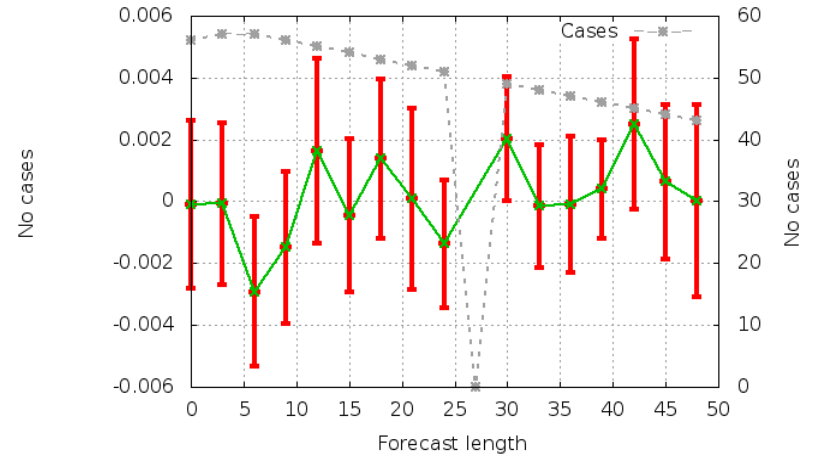
# Forecast impact: SYNOP U10m

Hilde Storm

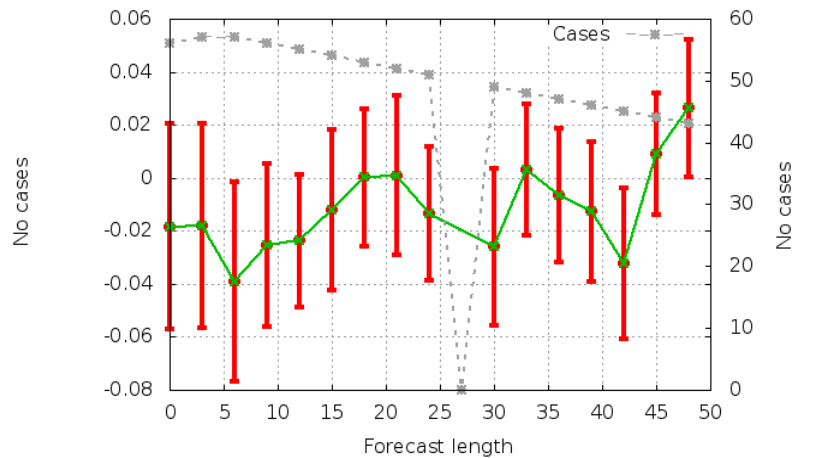
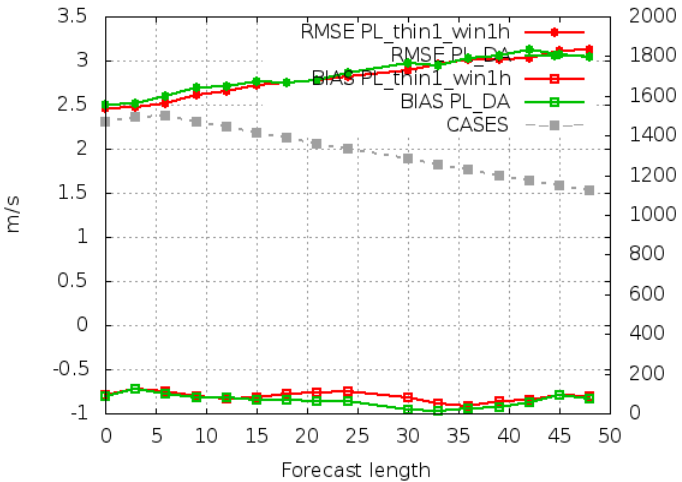
RMSE and bias of U10m



Difference (90 % confidence)



Polar low week



# Summary

## ASCAT data usage:

- Spatial coverage within the domain is good during daytime though data are strongly thinned
- Individual ambiguity selection problems close to fronts
- Data rejection issues

## Observation departures:

- Wind speeds are drawn from background closer to the observations. DA works reasonably.

## Forecast impact:

- Positive impact of scatterometer winds on SYNOP mslp
- Reduced thinning gives slightly improved forecasts
- No significant impact on other surface variables (yet)

# Plans

- Closer look on Polar lows and other high impact events
- Evaluation of storm core tracks for Polar lows

# Observed polar low tracks 2013-2014

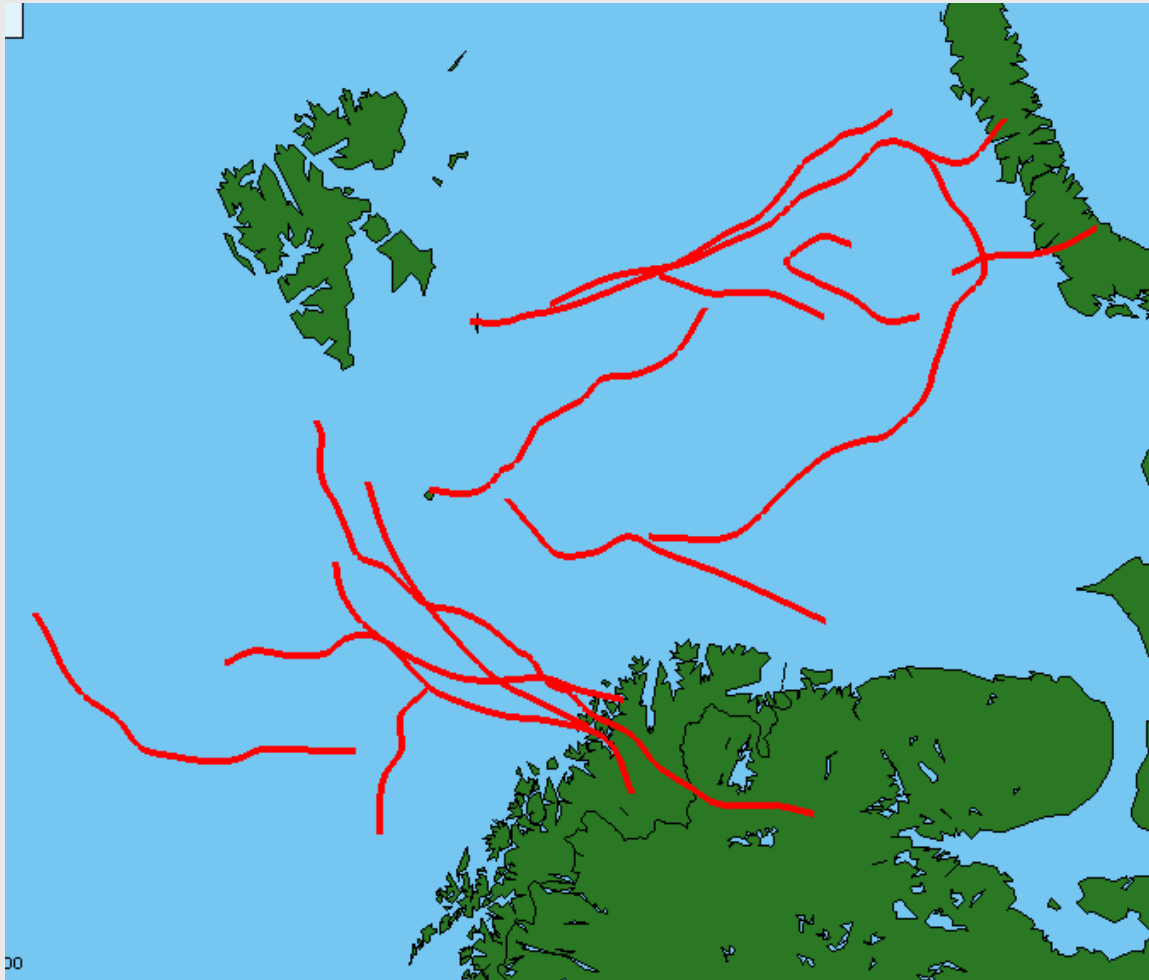


Figure: H. Luijting, MET Norway, Tromsø

# Plans

- Closer look on Polar lows and other high impact events
- Evaluation of storm core tracks for Polar lows
- Evaluation against radar reflectivity
- Work on optimal thinning distance, data rejection procedures and observation weighting
- Longer simulation periods for robust verification result
- Experiments on a newer HARMONIE version
- Operational implementation of scatterometer wind assimilation when actual
- Follow the shorter and longer term developments within the Hirlam NWP consortium, and apply and test new methods when available





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**Thank you!**

**Teresa Valkonen**  
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